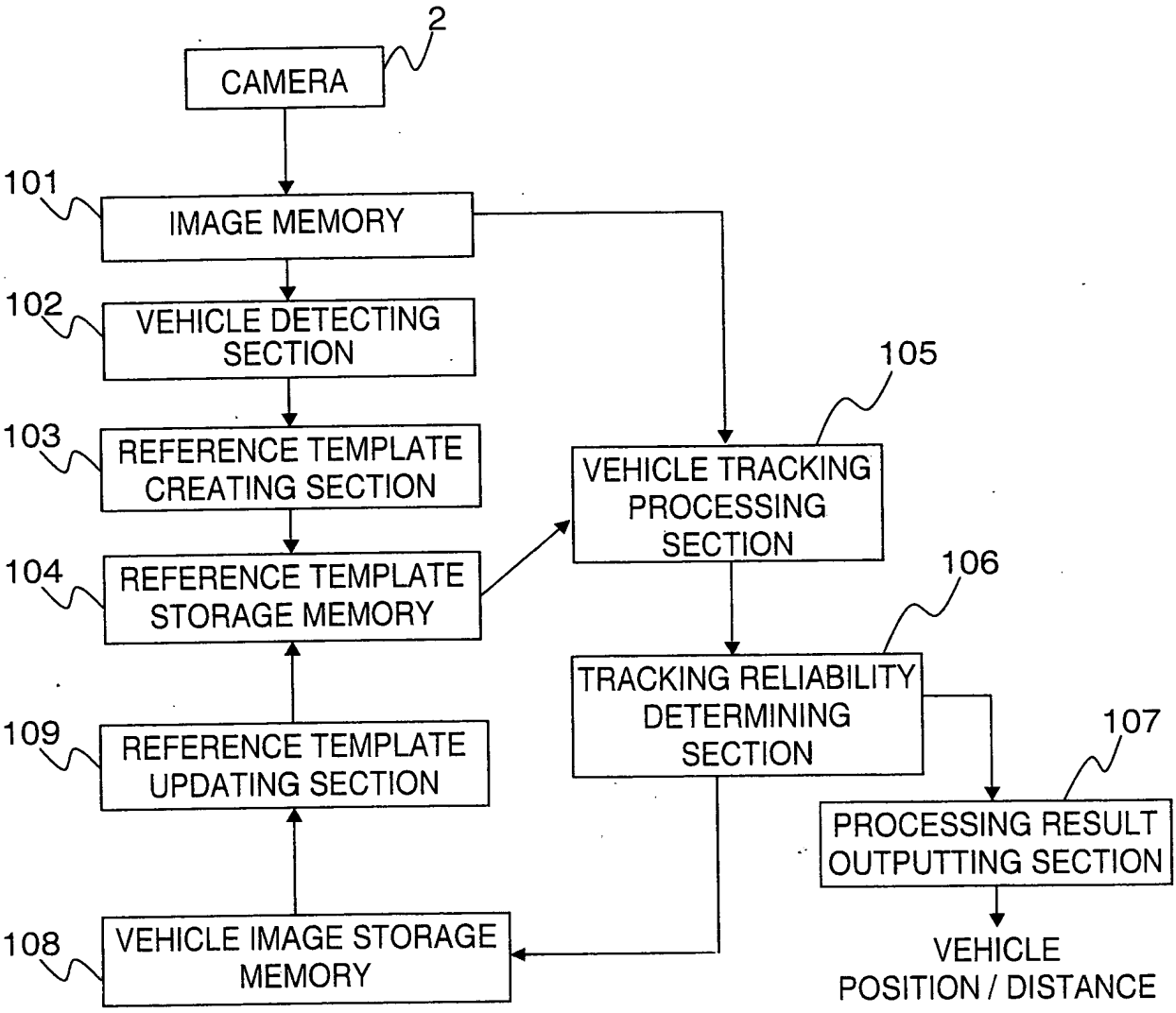

2
CAMERA
101
IMAGE MEMORY
102
VEHICLE DETECTING SECTION
103
REFERENCE TEMPLATE CREATING SECTION
104
REFERENCE TEMPLATE STORAGE MEMORY
109
REFERENCE TEMPLATE UPDATING SECTION
108
VEHICLE IMAGE STORAGE MEMORY
105
VEHICLE TRACKING PROCESSING SECTION
106
TRACKING RELIABILITY DETERMINING SECTION
107
PROCESSING RESULT OUTPUTTING SECTION
VEHICLE POSITION / DISTANCE

Fig. 1

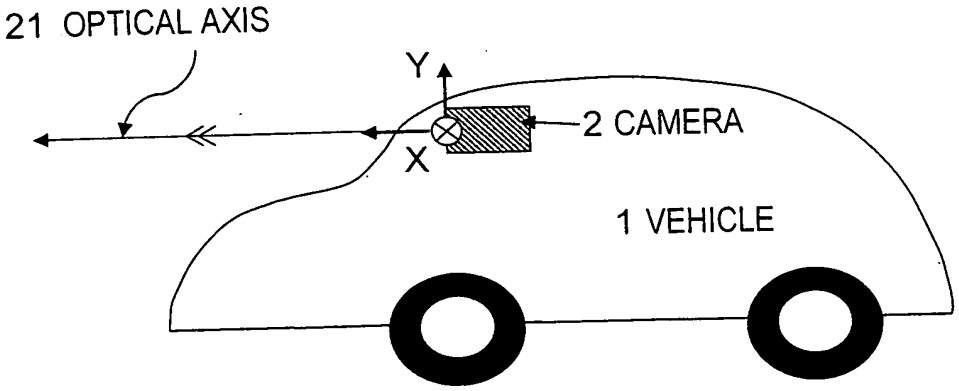

21 OPTICAL AXIS
Y
X
2 CAMERA
1 VEHICLE

Fig. 2 (a)

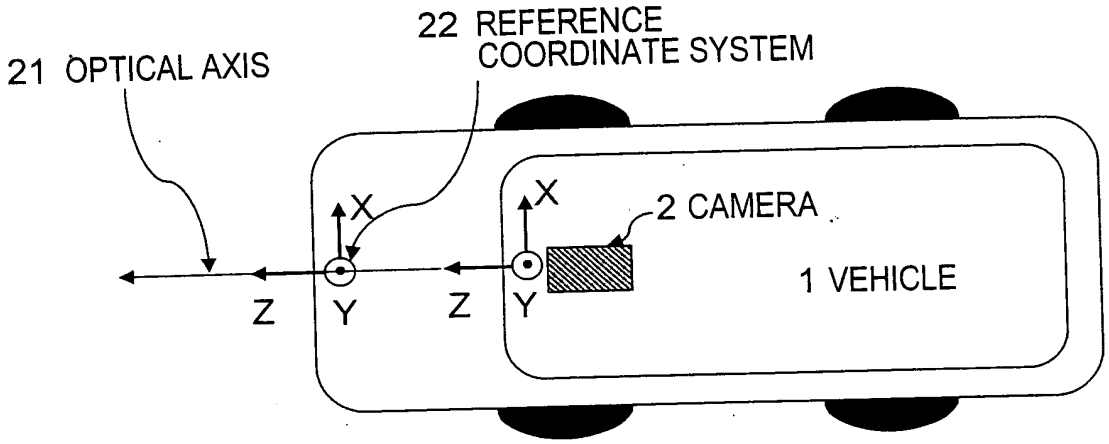

21 OPTICAL AXIS
22 REFERENCE
COORDINATE SYSTEM
X
Z
Y
X
Z
Y
2 CAMERA
1 VEHICLE

Fig. 2 (b)

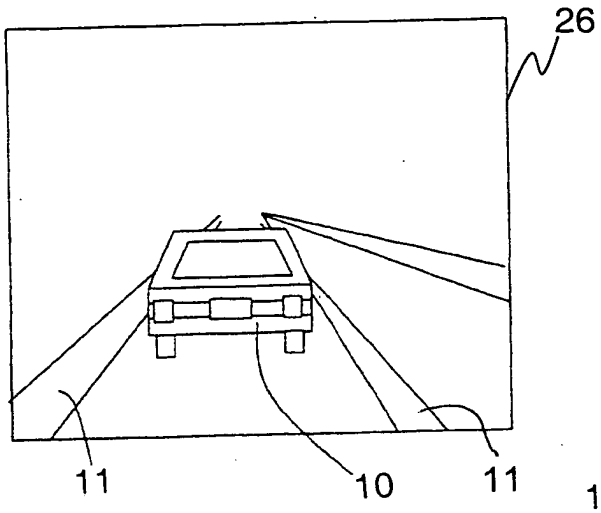


Fig. 3(a)

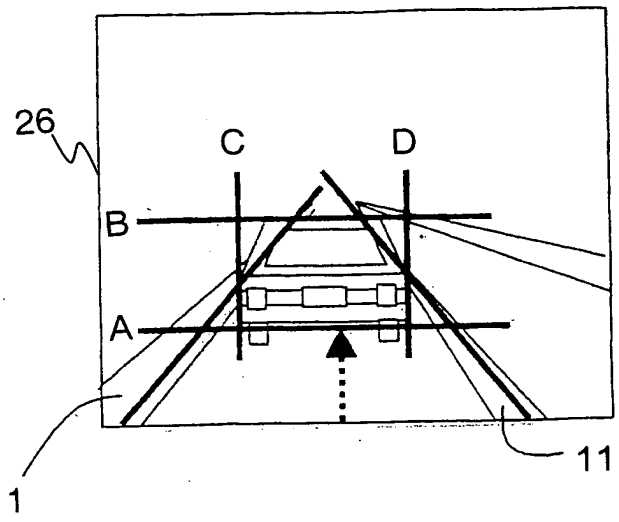


Fig. 3(b)

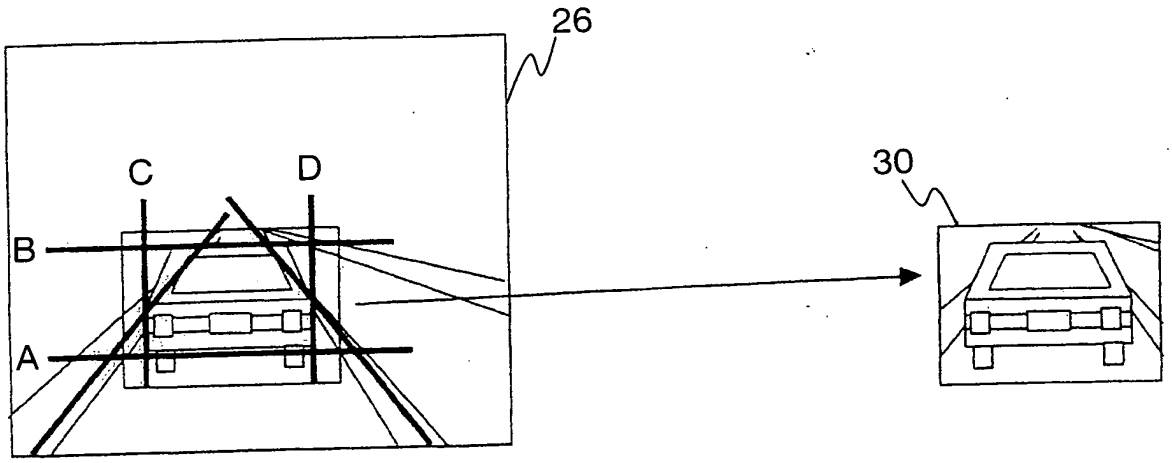


Fig. 3(c)

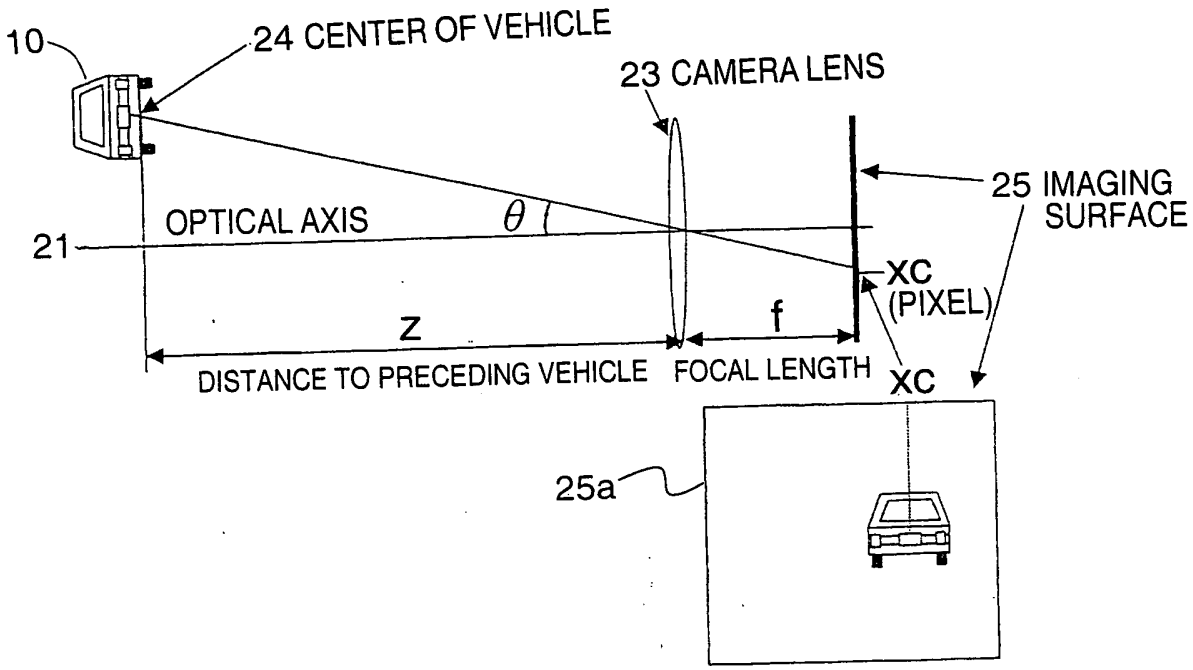

10
24 CENTER OF VEHICLE
23 CAMERA LENS
25 IMAGING SURFACE
OPTICAL AXIS
θ
21
XC (PIXEL)
Z
f
DISTANCE TO PRECEDING VEHICLE
FOCAL LENGTH
XC
25a

Fig. 4(a)

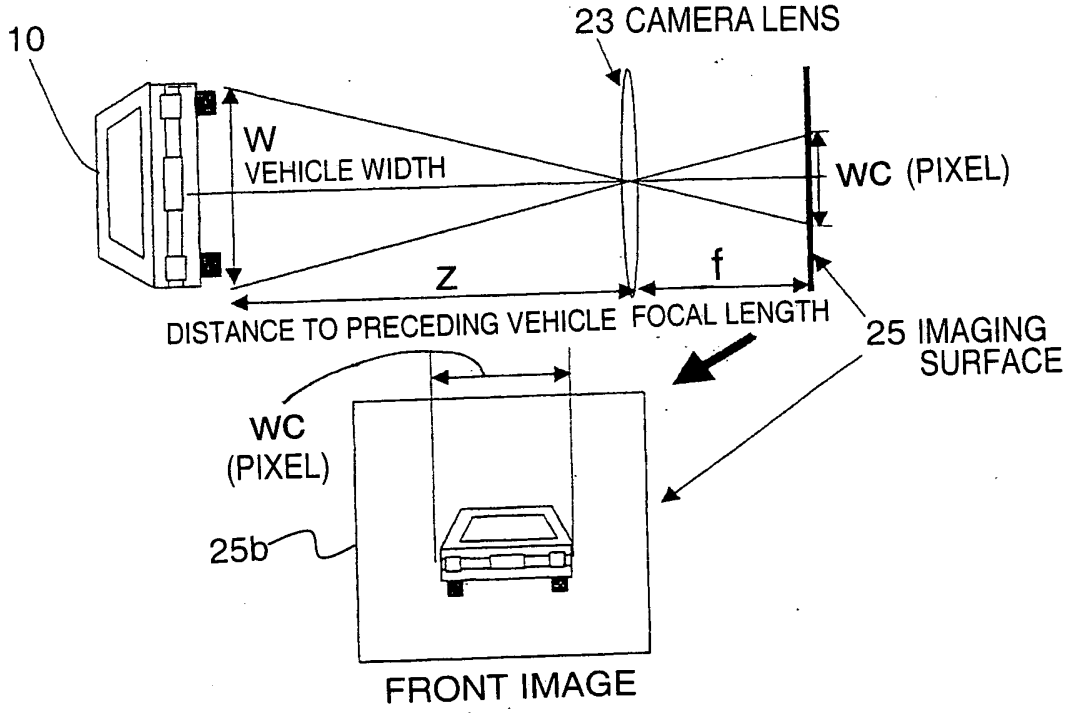

10
23 CAMERA LENS
W
VEHICLE WIDTH
WC (PIXEL)
Z
f
DISTANCE TO PRECEDING VEHICLE
FOCAL LENGTH
25 IMAGING SURFACE
WC
(PIXEL)
25b
FRONT IMAGE

Fig. 4(b)

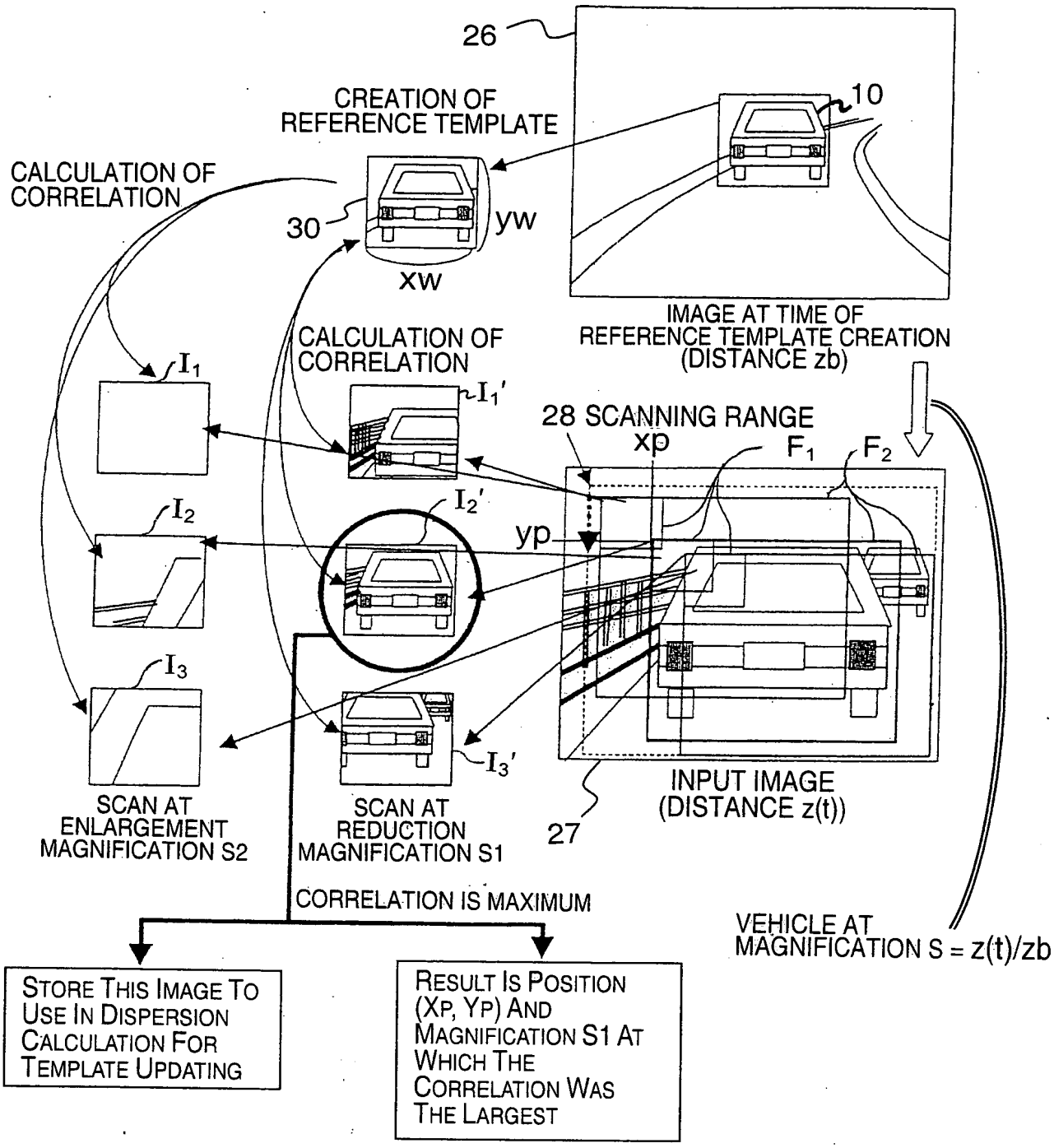

26
10
CREATION OF REFERENCE TEMPLATE
CALCULATION OF CORRELATION
30
yw
xw
IMAGE AT TIME OF REFERENCE TEMPLATE CREATION (DISTANCE zb)
CALCULATION OF CORRELATION
I1
I1'
28 SCANNING RANGE
xp
F1
F2
I2
I2'
yp
I3
I3'
SCAN AT ENLARGEMENT MAGNIFICATION S2
SCAN AT REDUCTION MAGNIFICATION S1
27
INPUT IMAGE (DISTANCE z(t))
CORRELATION IS MAXIMUM
VEHICLE AT MAGNIFICATION S = z(t)/zb
STORE THIS IMAGE TO USE IN DISPERSION CALCULATION FOR TEMPLATE UPDATING
RESULT IS POSITION (XP, YP) AND MAGNIFICATION S1 AT WHICH THE CORRELATION WAS THE LARGEST

Fig. 5

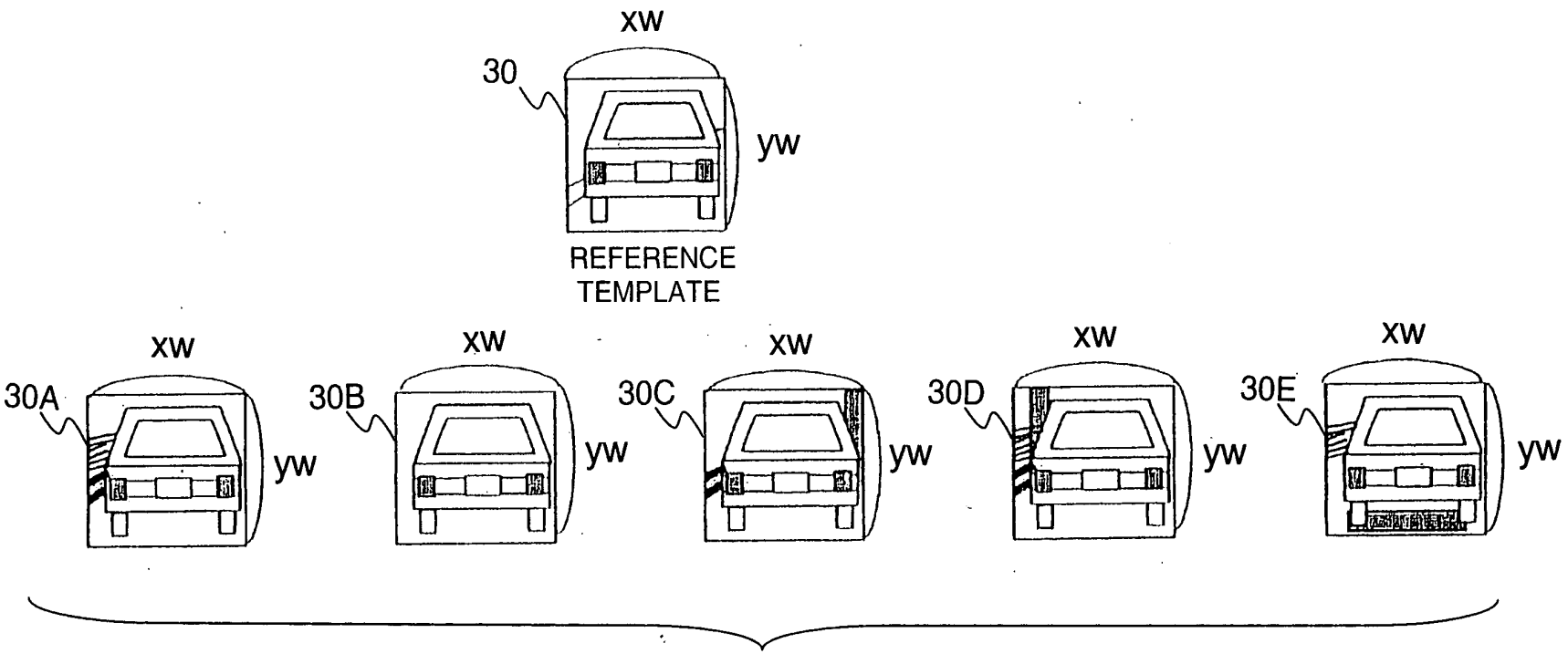

xw
30
yw
REFERENCE
TEMPLATE
xw
30A
yw
xw
30B
yw
xw
30C
yw
xw
30D
yw
xw
30E
yw

Fig. 6

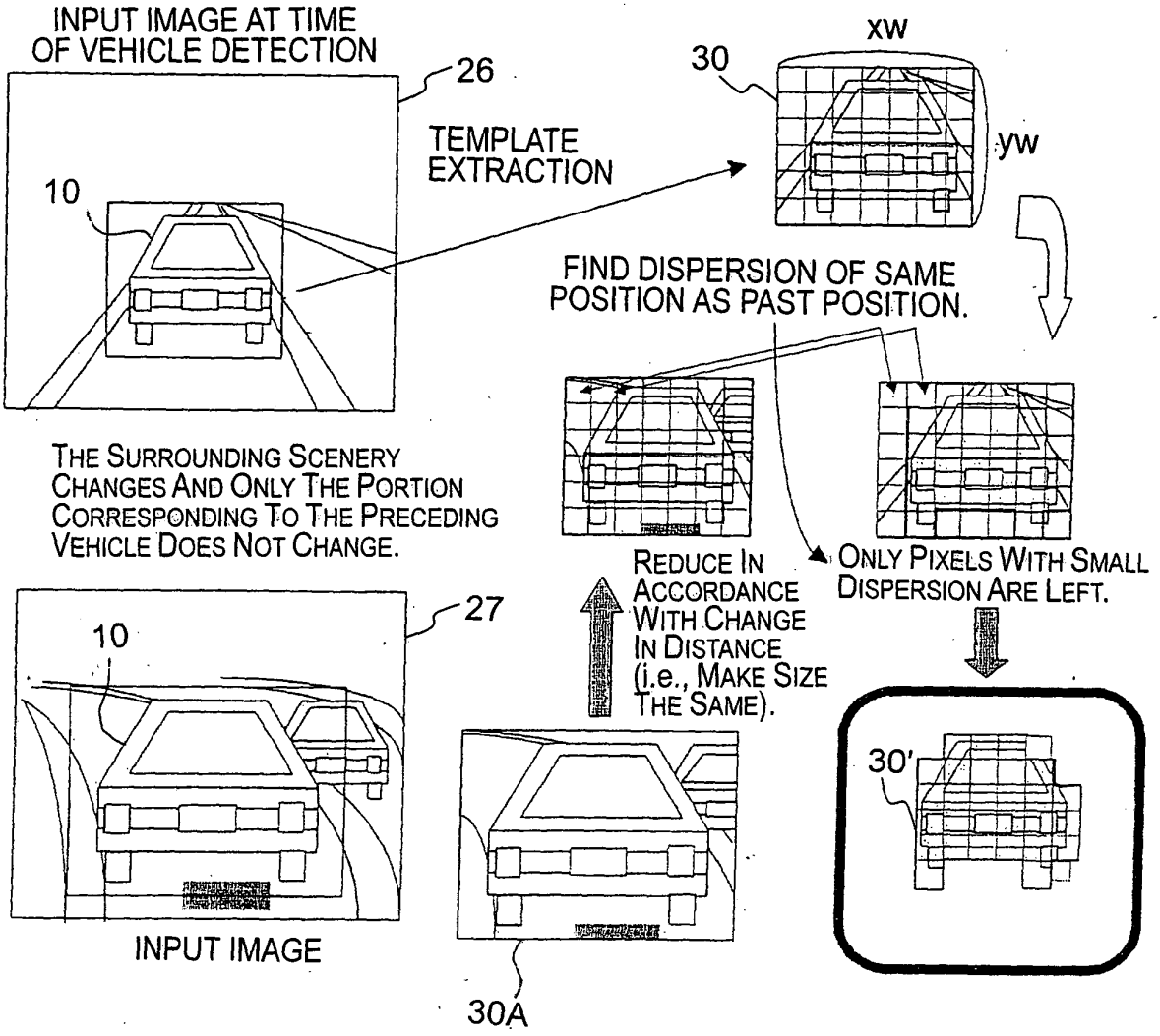
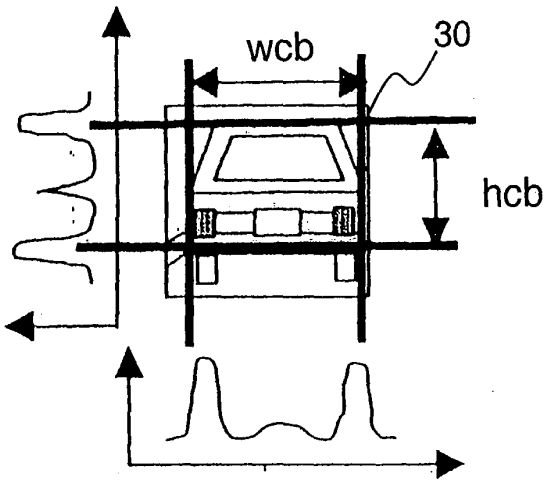

INPUT IMAGE AT TIME OF VEHICLE DETECTION
26
10
TEMPLATE EXTRACTION
30
xw
yw
FIND DISPERSION OF SAME POSITION AS PAST POSITION.
THE SURROUNDING SCENERY CHANGES AND ONLY THE PORTION CORRESPONDING TO THE PRECEDING VEHICLE DOES NOT CHANGE.
ONLY PIXELS WITH SMALL DISPERSION ARE LEFT.
REDUCE IN ACCORDANCE WITH CHANGE IN DISTANCE (i.e., MAKE SIZE THE SAME).
27
10
INPUT IMAGE
30A
30'

Fig. 7



DISTANCE AT TIME OF
REFERENCE TEMPLATE CREATION: zb

Fig. 8(a)

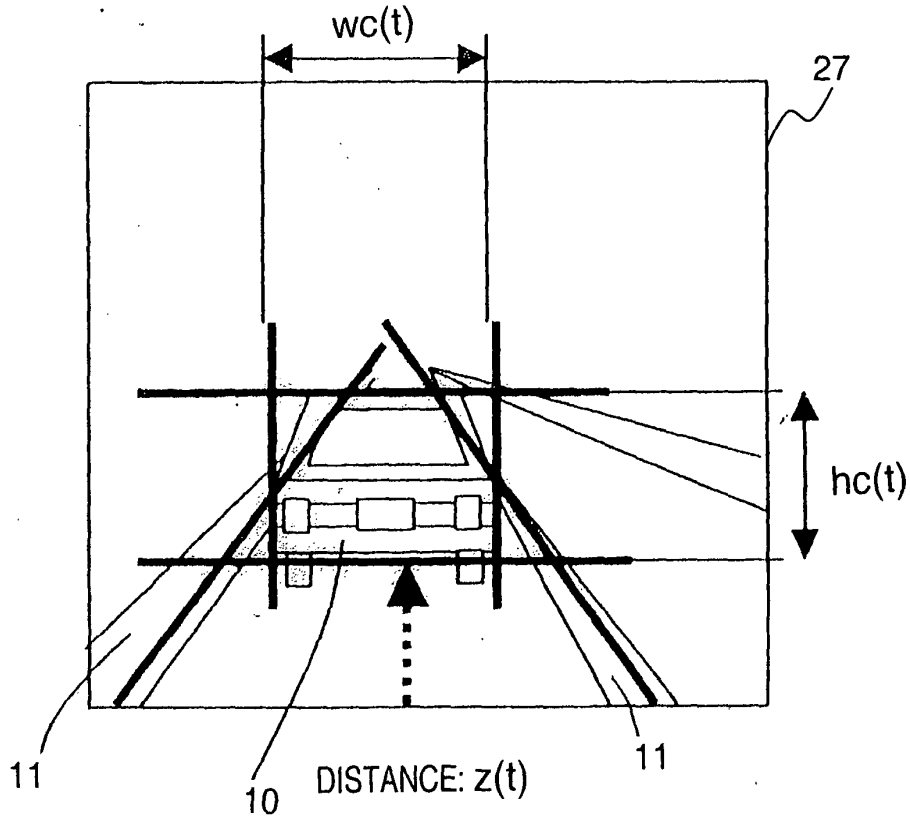


Fig. 8(b)

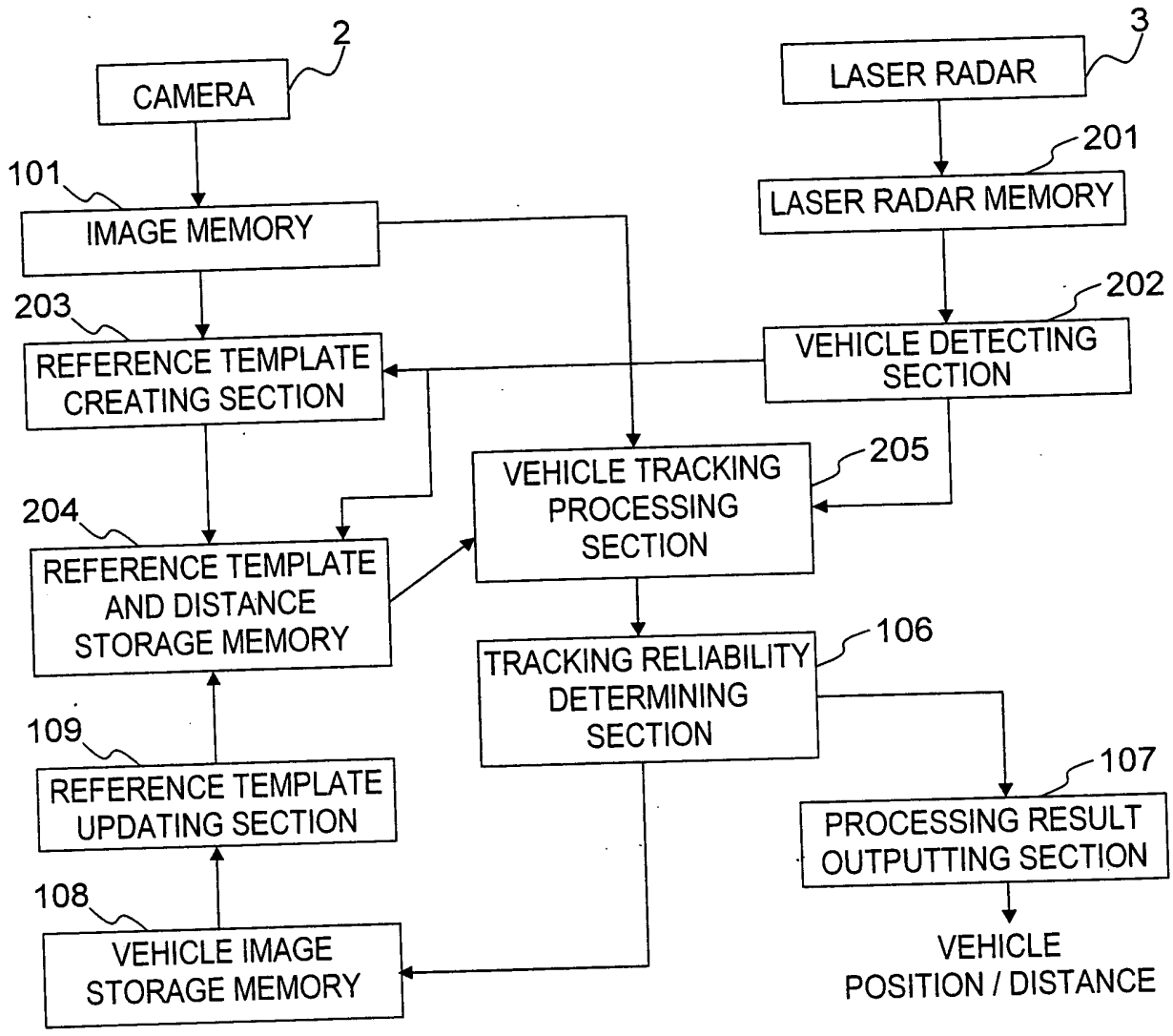

CAMERA
2
LASER RADAR
3
101
IMAGE MEMORY
201
LASER RADAR MEMORY
203
REFERENCE TEMPLATE CREATING SECTION
202
VEHICLE DETECTING SECTION
205
VEHICLE TRACKING PROCESSING SECTION
204
REFERENCE TEMPLATE AND DISTANCE STORAGE MEMORY
106
TRACKING RELIABILITY DETERMINING SECTION
109
REFERENCE TEMPLATE UPDATING SECTION
107
PROCESSING RESULT OUTPUTTING SECTION
108
VEHICLE IMAGE STORAGE MEMORY
VEHICLE POSITION / DISTANCE

Fig. 9

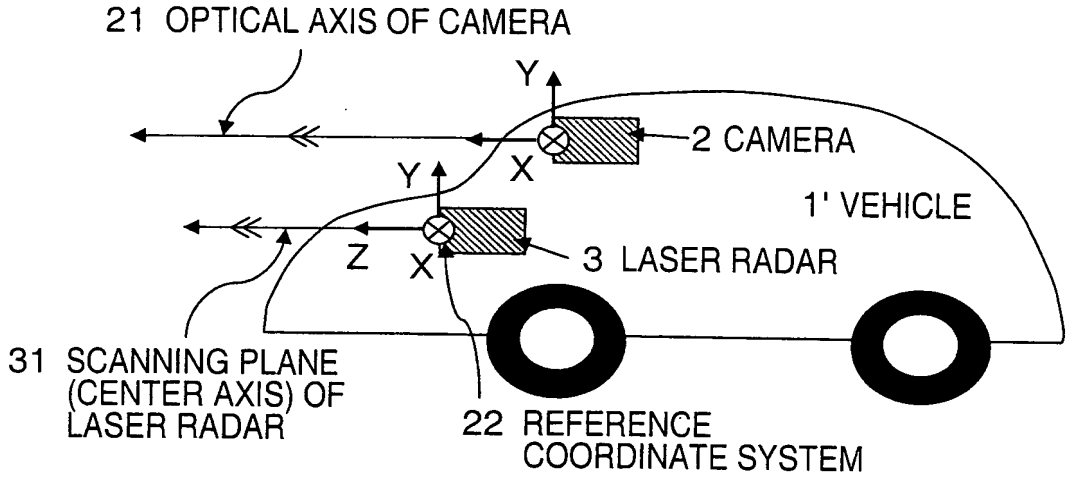


Fig. 10 (a)

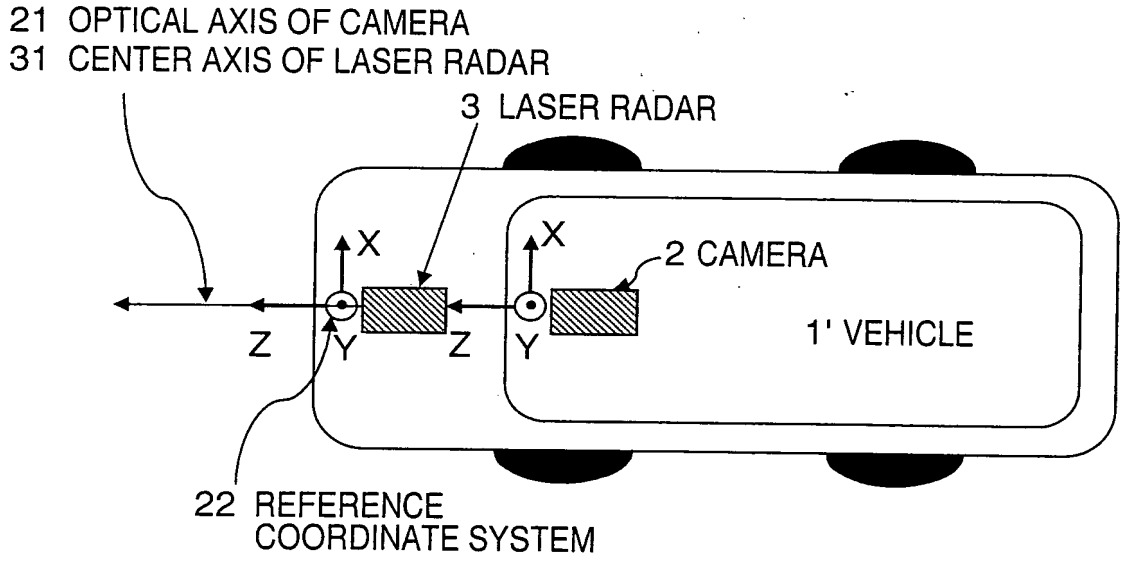


Fig. 10 (b)

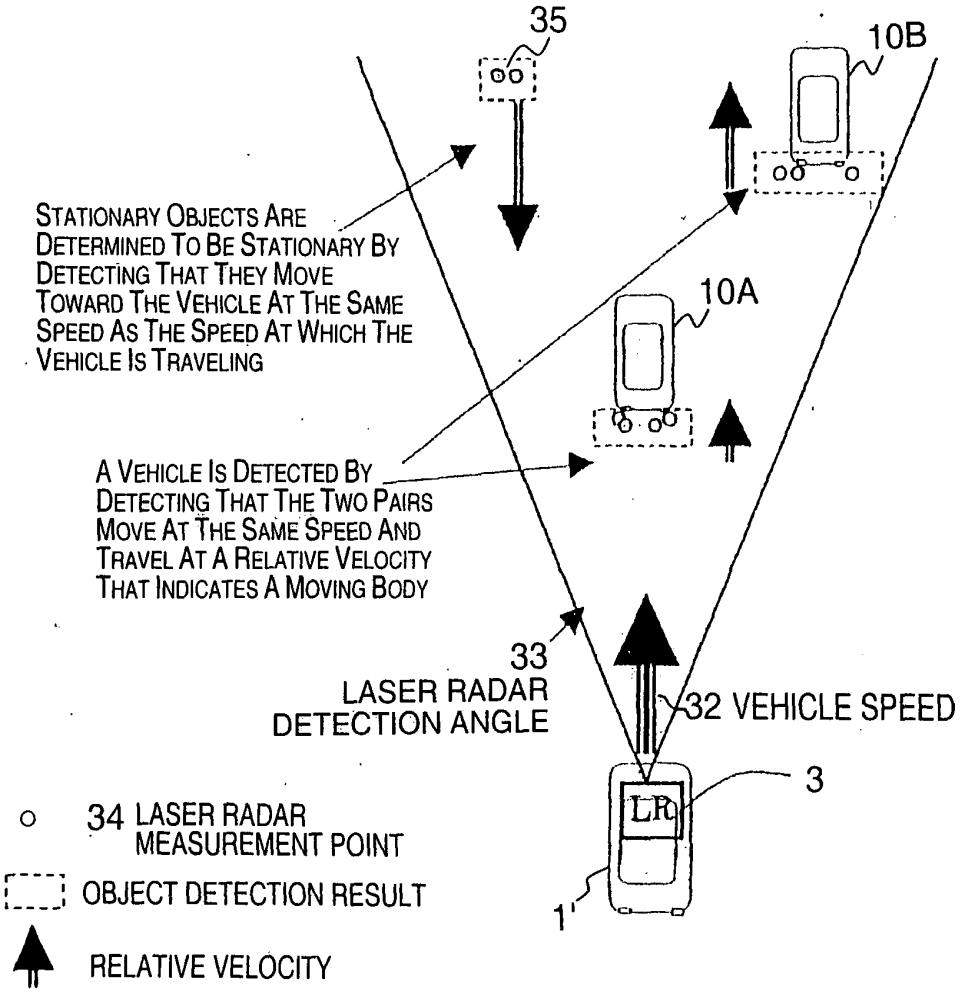


Fig. 11(a)

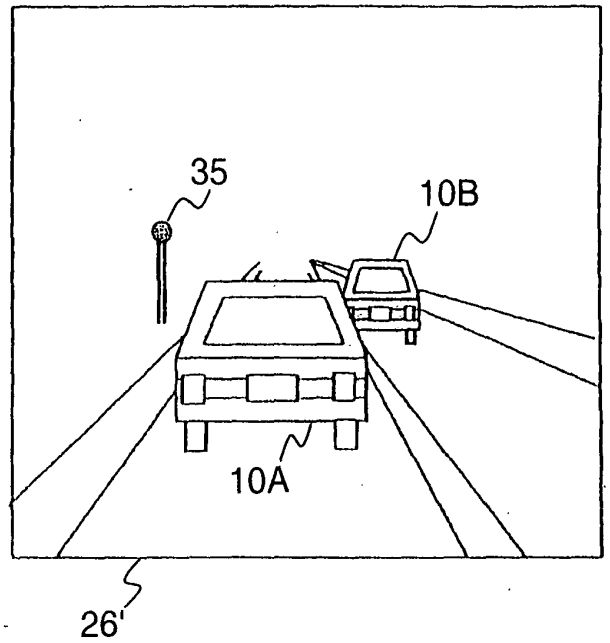


Fig. 11(b)

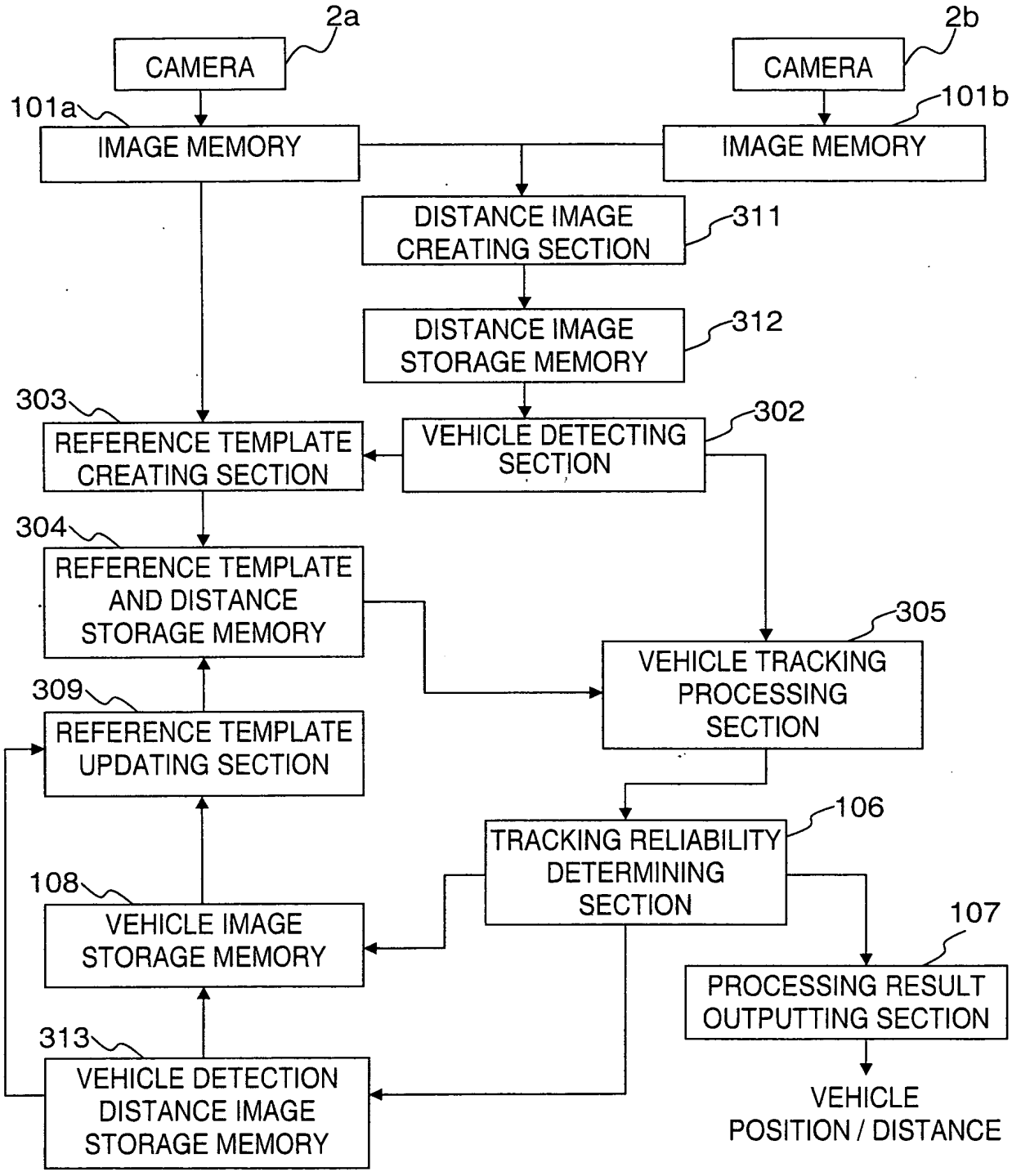

2a
CAMERA
2b
CAMERA
101a
IMAGE MEMORY
101b
IMAGE MEMORY
DISTANCE IMAGE CREATING SECTION
311
DISTANCE IMAGE STORAGE MEMORY
312
303
REFERENCE TEMPLATE CREATING SECTION
VEHICLE DETECTING SECTION
302
304
REFERENCE TEMPLATE AND DISTANCE STORAGE MEMORY
305
VEHICLE TRACKING PROCESSING SECTION
309
REFERENCE TEMPLATE UPDATING SECTION
106
TRACKING RELIABILITY DETERMINING SECTION
108
VEHICLE IMAGE STORAGE MEMORY
107
PROCESSING RESULT OUTPUTTING SECTION
313
VEHICLE DETECTION DISTANCE IMAGE STORAGE MEMORY
VEHICLE POSITION / DISTANCE

Fig. 12

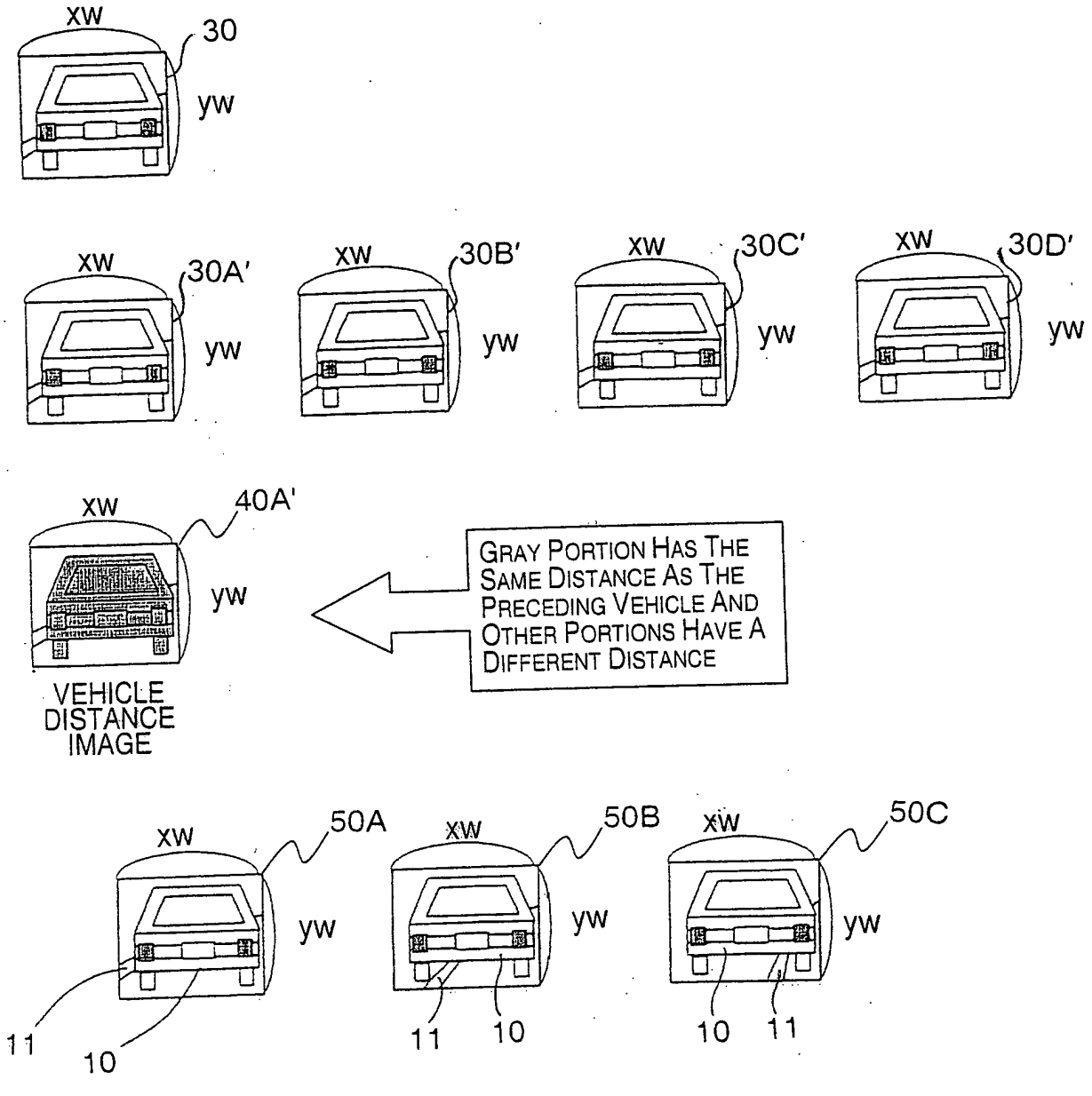

xw
30
yw
xw
30A'
yw
xw
30B'
yw
xw
30C'
yw
xw
30D'
yw
xw
40A'
yw
VEHICLE DISTANCE IMAGE
GRAY PORTION HAS THE SAME DISTANCE AS THE PRECEDING VEHICLE AND OTHER PORTIONS HAVE A DIFFERENT DISTANCE
xw
50A
yw
11
10
xw
50B
yw
11
10
xw
50C
yw
10
11

Fig. 13

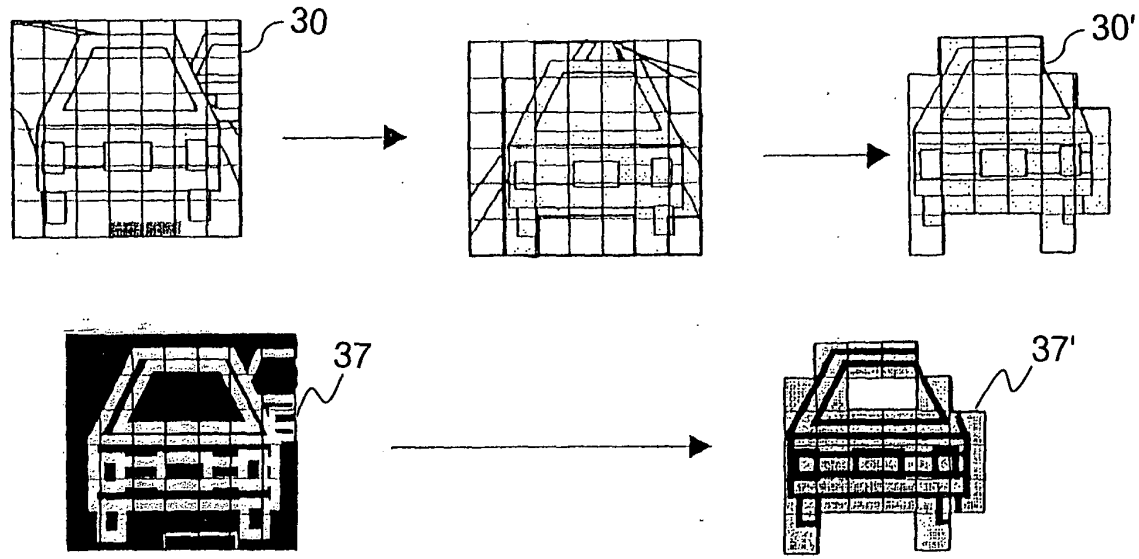


Fig. 14